

# Sustainable Packaging for a Rocket Component

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| <b>Difficulty</b><br>Intermediate | <b>Time</b><br>2-3 class periods | <b>Type</b><br>Aerospace Mission |
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## Background

A precision rocket component must be shipped to a test site. The package must protect the part while minimizing material and waste.

## Engineering Problem

Design, build, and test sustainable packaging for a provided component.

## Learning Objectives

- Balance protection and material use
- Apply life-cycle thinking
- Design packaging around a product
- Use test evidence to revise a solution

## Materials

- Provided rocket component or surrogate
- Corrugated cardboard, paperboard, paper, or approved recycled material
- Scale
- Ruler
- Drop-test area
- Engineering notebook

## Procedure

1. Measure the component and identify surfaces that must be protected.
2. Define shipping hazards such as drop, vibration, abrasion, and moisture.
3. Set criteria for protection, package size, mass, material type, and recyclability.
4. Sketch three packaging concepts using minimal material.
5. Select and build one concept.
6. Record package mass and external dimensions.
7. Perform three approved drop tests from increasing heights.
8. Inspect the part and package, revise one feature, and retest.

## Engineering Requirements

- Prevent visible damage in three approved drop tests
- Use at least 70% recyclable or reusable material by mass
- Use no loose plastic foam
- Keep package volume below the instructor-set limit
- Allow the component to be removed without damage

## Constraints & Safety

- Use only approved drop heights and test area
- No hazardous or messy filler
- Component must be returned in original condition
- Adhesive use must be measured or documented

## Deliverables

- Hazard and criteria list
- Three concept sketches
- Material and mass record
- Final package
- Drop-test results
- Sustainability justification
- Revision notes

## Reflection Questions

1. Which hazard controlled the design?
2. Where was material unnecessary?
3. How did protection compete with sustainability?
4. What would change for repeated shipping?

### Engineering Tip

Protect the component by controlling movement and distributing impact, not just by adding more material.

### Common Mistake

A package made from recyclable material is not sustainable if it uses far more material than necessary.

## Stretch Goal

Design a reusable package that completes ten shipping cycles.

## Career Connection

Packaging, logistics, and aerospace quality engineers protect expensive parts while controlling mass, cost, contamination, and waste.